No. 71-485

IN THE

Supreme Court of the United States

OCTOBER TERM, 1972

ROBERT GOTTSCHALK, COMMISSIONER OF PATENTS,
Petitioner,

v.

GARY R. BENSON AND ARTHUR C. TALBOT,
Respondents.

ON WRIT OF CERTIORARI TO THE UNITED STATES COURT OF CUSTOMS AND PATENT APPEALS

BRIEF FOR RESPONDENTS

HUGH B. COX
HERBERT P. SAUBER
MICHAEL BOUDIN
888 Sixteenth Street, N.W.
Washington, D.C. 20006

WILLIAM L. KREMPAUVER
ROBERT O. NEMETH
600 Mountain Avenue
Murray Hill, New Jersey 07974

Attorneys for Respondents

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TABLE OF CITATIONS

CASES:

Anderson's-Black Rock, Inc. v. *Pavement Salvage Co., Inc.*, 396 U.S. 57 (1969) .....
Baker v. *Selden*, 101 U.S. 99 (1879) .....
Brenner v. *Manson*, 383 U.S. 519 (1966) 21,
Chesterfield v. *United States*, 159 F. Supp. 371 (Ct. Cl. 1958) .....
Cochrane v. *Deener*, 94 U.S. 780 (1877) 9, 18, 21, 26,
Corning v. *Burden*, 56 U.S. (15 How.) 252 (1853) .....
Deep South Packing Co. v. *Laitram Corp.*, 40 U.S.L.Wk. 4575 (U.S., May 30, 1972) .....
DeForest Radio Co. v. *General Electric Co.*, 283 U.S. 664 (1931) .....
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Eibel Process Co. v. *Paper Co.*, 261 U.S. 45 (1923) ..
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General Talking Pictures Corp. v. *Western Electric Co.*, 304 U.S. 175 (1938) .....
Graham v. *John Deere Co.*, 383 U.S. 1 (1966) .....
Grant v. *Raymond*, 31 U.S. (6 Pet.) 218 (1832) .....
In re Bernhard, 417 F.2d 1395 (C.C.P.A. 1969) .....
In re Mahony, 421 F.2d 742 (C.C.P.A. 1970) .....

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In re Musgrave, 431 F.2d 882 (C.C.P.A. 1970) 62
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In re Tarczy-Hornoch, 397 F.2d 856 (C.C.P.A. 1968) .. 39
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Lauritzen v. *Larsen*, 345 U.S. 571 (1953) 65
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Medical Committee for Human Rights v. *SEC*, 432 F.2d 659 (D.C. Cir. 1970), *vacated as moot*, 404 U.S. 403 (1972) 56
Neely v. *Eby Construction Co.*, 386 U.S. 1, 317 (1967) 34
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Scott Paper Co. v. *Marcalus Co.*, 326 U.S. 249 (1945) ..43-44
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United States v. *Dubilier Condenser Corp.*, 289 U.S. 178 (1933) 43, 59
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Waxham v. *Smith*, 294 U.S. 20 (1935) 9, 14, 37, 39-40
White-Smith Music Co. v. *Apollo Co.*, 209 U.S. 1 (1908) 64

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Atomic Energy Act of 1954:

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Section 151(b), 42 U.S.C. § 2181(b) 64
Section 157(b)(3), 42 U.S.C. § 2187(b)(3) 64

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MISCELLANEOUS:

Attorney General's Committee to Study the Antitrust Laws, *Report* (1955) 50
Bender, "Computer Programs: Should They Be Patentable?," 68 *Colum. L. Rev.* 241 (1968) 45, 48, 52, 55-56
Bus. Week, Oct. 21, 1967 45
Comment, 54 *Cornell L. Rev.* 586 (1969) 44, 50
Electronic News, May 8, 1967 45
Kohler & Moshman, "Patent Protection for Computer Software: Implications for the Industry," 12 *Idea* 1109 (1969) 45
W. Leontief, *Essays in Economics* (1966) 43
Note, 64 *Colum. L. Rev.* 1274 (1964) 48
Patent Office, *Manual of Classification* 6, 27
Report of the President's Commission on the Patent System (1966), reprinted in S. Doc. No. 5, 90th Cong., 1st Sess. (1967) 43, 61, 65
SHARE Reference Manual (1971) 55
Statement of Dr. Ruth M. Davis, *Hearings of the Government Activities Subcommittee of the House Committee on Government Operations*, May 16, 1972 45
Statement of George F. Metcalf, *Hearings before Subcommittee No. 3 of the House Committee on the Judiciary on H.R. 5924*, 90th Cong., pt. 2 (1968) .. 56
Wall St. J., Aug. 3, 1972, p. 2 .....50, 52
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BRIEF FOR RESPONDENTS

QUESTION PRESENTED

Whether a useful, novel and unobvious method for conversion in an electrical data processing machine of electrical signals representing binary-coded decimal numbers into electrical signals representing binary numbers of equivalent value is a patentable invention under 35 U.S.C. § 101?

STATEMENT

I. Background of the Invention

In the early 1960's when the respondents made the invention involved in this case they were engaged in the development of a telephone switching system of a type known as a private branch exchange or "PBX". A PBX is typically used in an office building or hotel to interconnect the telephones in a building to each other and to telephones in the outside world. To accomplish this interconnection, the PBX receives electrical dial impulses or "signals" from the telephone of the party placing the call; it identifies the particular telephone being called; and based on that identification the PBX apparatus interconnects the two telephones.

The particular model PBX being developed employed apparatus elements that, instead of being wired together in a fixed manner, could be flexibly interconnected under the control of a stored set of electrical signals.[1] The mechanism for achieving this flexibility was a device called a control unit which was similar in many respects to the machine commonly known as a digital computer. In essence, a modern digital computer is a data processing machine that utilizes electrical signals both to control its operations and to represent data within the machine. The computer stores electrical data signals and, in response to the control signals, can retrieve and organize the data signals to assemble lists, search for selected words, effect arith-

[1] For a general description of respondents' PBX see Williford, "The No. 101 Electronic Switching System," *Bell Laboratories Record*, November 1963, p. 374.

metic operations, and perform other tasks with the data signals.[2]

The control unit in respondents' PBX, while similar to a computer, was not a computer in the usual sense of the word since its basic function was limited to controlling telephone connections. Thus, it lacked many of the functional capabilities and apparatus components or "hardware" of a typical general purpose computer. However, the PBX control unit and general purpose computer are both data processing machines that operate with electrical signals and both utilize a technique known as stored program control in which the control signals may be stored within the machine itself.

When a sequence of control signals or "program" stored in the computer is set in operation, apparatus elements transfer data signals between different locations within the machine and generate, cancel, or otherwise manipulate such signals in order to perform specific programmed functions.[3] The same processing of signals could be accomplished by a fixed wired electrical circuit designed to execute prescribed functions. However, a programmable computer can store and carry out a variety of different programs and the programs themselves can be altered or replaced. The computer can therefore have a greater repertoire of

[2] A more detailed discussion of computer operations and related notation systems is contained in part I of the Appendix to this brief (pp. 1a-5a below). Part II of the Appendix contains a description of respondents' invention. Part III includes an explanation of relevant mathematical techniques.

[3] A "program" is a series of instructions that controls the operation of a data processing machine. During their preparation, these instructions may be represented in words, but they are ultimately encoded in a sequence of electrical control signals to operate the computer. See Appendix (pp. 1a-2a, below).

operations with less fixed wired circuitry, and its operations can be changed readily without rewiring the machine.

In respondents' PBX, as in most modern digital computers, only two forms of electrical signals or conditions are employed to represent all data; for example, these signals might be the "on" and "off" states of an electrical device such as a transistor or the presence or absence of an electrical pulse in a circuit. The two alternative signal conditions are often represented by the symbols "1" and "0". Different sequences of electrical signals in the computer may be regarded as representing names, letters, numbers or any other data desired by the programmer.

When the data to be stored in or utilized by a computer is numerical, it is usually convenient to represent it inside the machine by the binary numbering system. In the decimal numbering system ten digits—0 through 9—are used and a digit in each successive position left of the decimal point has a numerical or "positional" value ten times greater than it would have in the preceding position.[4] In the binary numbering system, however, all numerical values are represented only by use of the digits 1 and 0 and each successive digit left of the decimal is only twice the numerical value of the same digit in the preceding position.[5] The

[4] In this brief, "digit" refers to the individual member or members of a number and "number" includes the entire numerical expression (*e.g.*, 2 is a digit in the number 23).

[5] For example, in the decimal number 111, the first digit reading right to left has a numerical value of 1, the second of 10, and the third of 100; the value of the whole number is one hundred eleven. In the binary number 111, the first digit has a value of 1, the second of 2, and the third of 4; the value of the whole number is seven. The base or "radix" of the decimal system is thus the numerical value 10 and the base of the binary system is 2. See Appendix (pp. 3a-4a, below).

ready correspondence between the two forms of electrical signals in the computer and the two digits of the binary numbering system make binary numbers highly suitable for computer use.

Another form of notation, intermediate between decimal and binary, is called the binary-coded-decimal or "BCD" numbering system. In a BCD number, only the digits 1 and 0 are used, but a BCD number is merely successive sets of four-digit binary numbers, each set of which corresponds directly to a single digit in the decimal number being represented in BCD form.[4] It is often desirable in translating a decimal number into a binary number first to convert the decimal number into a BCD number and then to convert the BCD number into a binary number. For example, in dialing a telephone, each turn of the dial normally transmits a set of pulses representing one decimal digit. It simplifies the required circuitry if each such set of pulses is independently converted into four binary signals equivalent to the original digit. The entire sequence of signals will then represent the telephone number in BCD form. See Appendix (p. 5a, below).

II. Respondents' Invention

In the PBX telephone system with which respondents were concerned the signals transmitted from the calling telephone arrived at the control unit in BCD

[4] For example, the decimal number 53 would be expressed in BCD form as the combination of the separate binary equivalents of 5 (0101) and 3 (0011), *i.e.*, 0101/0011. Accordingly, the BCD number, although consisting of 1's and O's, is not a true binary number; this because the positional values of the 1's and O's are different than they are in true binary notation except for the first four positions in the number. The true binary equivalent of 53 is 110101. A further explanation of BCD numbering is contained in the Appendix (pp. 4a-5a, below).

form, and the machine's operation required their conversion into binary signals before interconnection could be accomplished. At the time of respondents' invention, there existed a number of different ways to accomplish this BCD-to-binary conversion of electrical signals. These included methods which rely on fixed wired electrical circuits, a number of which are patented, and methods that may be embodied in programs suitable for use in digital computers.[7]

All of the methods known to respondents for making the BCD-to-binary conversion in a digital computer required either the addition of multi-digit binary numbers or the storage in the computer of signals representing a large number of conversion values, or both. See Appendix (pp. 6a-7a, below). The first of these requirements could not be met in respondents' PBX since it did not have an "adder," which is a conventional apparatus capable of adding multi-digit binary numbers together. The second requirement was infeasible since the PBX had a limited storage capacity that could not as a practical matter be used to retain a large number of conversion values.

In studying the conversion problem respondents discovered a new method of employing a data processing apparatus to accomplish the conversion of BCD

[7] For classification purposes, all patents are assigned by the Patent Office to one of several hundred subject matter classes divided into numerous more specific subclasses. Patent Office, *Manual of Classification*. The Patent Office has an entire subclass—sub-class 155 of class 235—reserved for patents covering means of converting numbers in one type of system such as BCD to numbers in another type of system such as binary. Approximately 75 patents have been issued for means of converting between BCD signals and binary signals by the transmission of electrical signals through fixed wired circuits.

signals into binary signals. The method required the processing of the set of signals that represents the BCD number in a repetitive cycle. Each complete cycle involved the identification and elimination of one electrical signal and the introduction of two new signals at designated places in the original set of signals. This process produced at the end of the repetitive steps a set of signals representing a binary number equivalent in numerical value to the BCD number previously received and stored in the computer.

This method of conversion required neither the storage of numerous conversion values, nor the presence of a multi-digit adder. It employed existing circuits to identify or "test" signals, to eliminate or "mask" them and to "add" or increment them. The invention also took advantage of a "reentrant shift register" available in the PBX. Most computers employ a shift register of one type or another for manipulating signals, although frequently it is not of the "reentrant" type.[8] Using this device, the testing and masking function and the incrementing function could each be made to occur at a single location in the register which had certain practical advantages. Since the invented process itself is a physical one, involving the manipulation of electrical signals within the computer, its steps are most easily described in the form of dia-

[8] A "register" is a device which holds a set of electrical signals representing a limited number of digits so that they may be tested to determine the presence or absence of a pulse in a particular position, added to other digits, transferred to another location, or otherwise manipulated. A "reentrant shift register" is a register which has the capacity, in addition to holding the set of signals, to shift the entire set to the left or right so that signals that exit from one end of the shift register reappear at the other end in a cyclical pattern. See Appendix (pp. 7a-8a, below).

grams, and a complete diagrammatic description of the invention and its operation is contained in part II of the Appendix (pp. 7a-13a, below).

In inventing the process just summarized the respondents were assisted by their discovery of a particular mathematical relationship between BCD and binary numbers that had not previously been noted from which they derived a new technique for converting BCD numbers into binary form. The mathematical relationship and technique discovered by respondents, which is described in part III of the Appendix (pp. 14a-20a, below), provides an abstract explanation why the intended process works to produce a correct conversion of electrical signals representing a BCD number into electrical signals representing an equivalent binary number. The mathematical relationship and technique, however, are not the subject of any patent claim made by the respondents; they correspond to respondents' process invention in the same way that a law of chemistry corresponds to a newly invented process for producing a known medicine.

The process invented by respondents can be used generally in digital computers, although it is most useful for devices such as the PBX control unit which have limited equipment and storage capacity. The process has a basic characteristic that is highly desirable in computer operations: it can be implemented through a repetitive pattern of steps which uses the same set of electrical signals to control the machine over and over again during conversion. This not only lessens storage requirements but, for technical reasons, reduces the likelihood of mistakes in the conversion and simplifies preparation of complex programs to accomplish specific tasks.

III. The Proceeding Below

In October 1963, respondents filed an application for a patent on their process. A "process" is one of the basic statutory categories of patentable inventions. 35 U.S.C. § 101. Process patents, unlike machine or "apparatus" patents, are directed to the "process, art or method" (35 U.S.C. § 100(b)) of accomplishing a given result rather than the particular machinery or apparatus that carries out the process.[9] Indeed, "process" is defined by statute to include "a new use of a known . . . machine." 35 U.S.C. § 100(b).

Respondents' application was required by statute to include a "specification" describing the invention and the manner of making and using it and to include individual "claims" pointing out the subject matter claimed as the invention. 35 U.S.C. § 112. The subject matter of a patent is the invention, here a machine process, and not the words, numbers or concepts used in the description. Thus, the respondents' process can be described or explained with the assistance of words and mathematical operations; the process sought to be patented, however, is a physical one which occurs inside a machine and involves the generation, comparison and termination of electrical pulses in a particular way to achieve a particular end, *i.e.*, the conversion of BCD signals into equivalent binary signals.

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[9] Examples of process patents include a process for purifying flour (*Cochrane* v. *Deener*, 94 U.S. 780 (1877)); a way of extracting fat acids from glycerine (*Tilghman* v. *Proctor*, 102 U.S. 707 (1880)); a method of transmitting sounds electrically (*The Telephone Cases*, 126 U.S. 1 (1888)); a technique for making expanded sheet metal (*Expanded Metal Co.* v. *Bradford*, 214 U.S. 366 (1909)); and a process for artificially hatching eggs (*Waxham* v. *Smith*, 294 U.S. 20 (1935)).

Respondents' application described their invention as relating "to the processing of data by program and more particularly to the programmed conversion of numerical information" (R. 3). The detailed specification included a statement of the problems posed by existing conversion methods; the respondents' solution which utilized the "recurrent addition of a fixed quantity to registered signals" (R. 4); and the specific advantages of respondents' process which have been outlined above.[10] The specification contained an illustrative diagram of electrical apparatus suitable for performing the invention—relevant circuitry of respondents' PBX control unit (R. 15)—and an illustrative set of program instructions which implemented the invented process in respondents' PBX (R. 9).

The application concluded with the required statement of individual claims. The only two claims here at issue, claims 8 and 13, are set forth at R. 142-43 and reprinted in petitioner's brief (Pet. Br. 3-4, n.1). Claim 8 described a "method of converting signals" from BCD to binary form in terms that make clear that it is describing an electrical circuit process designed to be used in data processing devices. For example, the claim described steps including storage of the BCD "signals" in a "reentrant shift register," and the "shifting," "masking," and additive functions in the appropriate order (R. 142-43). Claim 13 described a "method for converting representations" from BCD to

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[10] The specification described these advantages as including among others a curtailing of the complexity of "the programming operations"; the elimination of "repetitive storing and retrieval"; enhanced accuracy "by eliminating the need for interchanging signals among various equipment components"; and accomplishment of conversion without the need for "auxiliary equipment" (R. 4-5).

binary similarly directed to an electrical circuit process, as is shown by both the words of the claim and by other considerations discussed at pp. 17-18 below.

Each claim is thus directed to a process to be performed in an electrical data processing machine. The purpose of the process is to effect BCD-to-binary signal conversions which are necessary or desirable in many computer operations in addition to respondents' PBX switching system. The application did not limit the claims to employment of the invented process in connection with telephone switching systems. While the immediate intended use of the process is in telephone switching systems, it has an advantage for computer operation in other cases where there are equipment limitations or a need to conserve storage space and reduce the likelihood of errors.

In the Patent Office proceedings, respondents' claims were considered in relation to the basic substantive requirements of the statute: proper subject matter, utility, novelty and unobviousness. 35 U.S.C. §§ 100-03. The utility of respondents' invention was not questioned at any stage. As is usual, a search was made of the relevant prior art, which here included patents issued on various means of BCD-to-binary signal conversion. See p. 6, n. 7 above. No prior art was cited against either of the claims here at issue at any point in the proceedings.[11]

The Patent Office Examiner rejected the claims here as issue on the sole ground that they covered subject matter "not embraced by 35 U.S.C. 101 in that they

[11] Rule 106(b) of the Patent Office, 37 C.F.R. § 1.106(b), requires an Examiner to specify the prior art on which he relies—*e.g.*, prior patents, scientific publications—when he rejects a claimed invention for lack of novelty or for obviousness.

set forth 'mental processes' and 'mathematical steps,' neither being an art . . ." (R. 137; see R. 135-36). The Examiner did not rest his rejection on any determination that the claims lacked novelty under Section 102 or that they failed to meet the requirement of Section 103 that the invention be non-obvious. 35 U.S.C. §§ 102-03. On appeal, the Patent Office's Board of Appeals upheld the Examiner's rejection, stating: "[W]e find we are in agreement with the position of the Examiner that the appealed claims set forth subject matter not embraced by 35 U.S.C. 101 within the term 'art' . . ." (R. 138). Once again, no suggestion was made that either claim 8 or claim 13 failed to meet the statutory standards of novelty and unobviousness.

The court below, addressing itself to the sole and precise ground for rejection adopted by the Patent Office, reversed, holding that the process claimed was directed to machine implementation and not to "mental processes" and "mathematical steps." 441 F.2d 682. The court first considered claim 8 and determined that it "covers only a machine-implemented process . . . ." *Id.* at 687. It then considered claim 13 and held that it was similarly limited because "realistically" it "has no practical use other than the more effective operation and utilization of a *machine* known as a digital computer." *Id.* at 688.

SUMMARY OF ARGUMENT

Respondents' invention is a machine process within the meaning of the Patent Act. Each of the claims is directed at the processing of electrical signals in an electrical data processing apparatus, as is shown by the wording of their claims, the specification, and other relevant considerations. Electrical signals have long been deemed proper workstuff for a patent (*e.g.*,

O'Reilly v. *Morse,* 56 U.S. (15 How.) 62 (1853), and a process as well as an apparatus claim for manipulation of electrical signals is legitimate. *E.g., The Telephone Cases,* 126 U.S. 1 (1888). The utility of the invented process is beyond question.

There is nothing in respondents' patent claims that makes them inconsistent with the proposition that an abstract idea or a series of mental steps may not be patented. The respondents have never sought to claim the mathematical relationship or technique they discovered but only the particular machine process they derived from the mathematical discovery. Such a practical application, having immediate use and specific advantages over the prior art, is the very essence of invention. See *Mackay Radio & Telegraph Co.* v. *Radio Corp. of America,* 306 U.S. 86, 94 (1939). Operations occurring inside an electrical data processing machine are not a series of mental steps.

The respondents' claims are confined to a process which is effected in a particular type of apparatus (an electrical data processing machine), which falls within a particular field of technology (data processing) and which has a particular end use (conversion of BCD signals to binary signals). There is no basis for petitioner's contention that more confining or particularized restrictions are necessary. The authorities petitioner cites—cases involving patent claims relating to the telegraph and the telephone—do not impose the narrower restrictions advanced by petitioner but in fact uphold patent claims far broader than those involved here. In data processing, BCD-to-binary signal conversion is a comparatively limited end use, and respondents' process, while possessing distinct advantages, is only one of a number of ways to accomplish such conversion.

Petitioner and amici are not at this stage entitled to object to respondents' claims on the grounds that they lack novelty, are obvious or attempt to patent the "inherent function" of a machine. These objections were not the basis of rejection in the Patent Office, were not raised or considered in the court below, and were not presented by the certiorari petition. In any event, no prior art has ever been cited by petitioner to establish that respondents' process is either not novel or is obvious, and this Court has rejected attempts to apply these standards based on a hindsight evaluation made easy by the inventors' own contribution. See *United States* v. *Adams*, 383 U.S. 39, 52 (1966). The inherent function doctrine, which is designed to prevent claims which extend to every means of producing a particular effect or result, has no application here since respondents have limited their claims to a particular set of steps that will lead to the particular result and not any other way of effecting BCD-to-binary signal conversion. See *Waxham* v. *Smith*, 294 U.S. 20, 21-22 (1935).

The policy arguments of petitioner and amici that computer processes and programs as a class should not be patentable are unsound. Patenting inventions of this kind, where they are new, useful and unobvious, will serve the traditional purposes of the patent laws: to stimulate discovery and development of new inventions and to encourage their public disclosure. The patenting of computer software will also strengthen the many small producers who currently compete in the software field with the few large corporations that also manufacture computer hardware and hold numerous apparatus patents. Neither the administrative inconvenience to petitioner of classifying patents in a new field nor the usual obligations of industry to comply with limitations imposed by the Patent Act

provide any basis for denying patents to computer processes and programs.

The policy arguments should also be rejected because they would require this Court to depart from its usual practice of judicially considering inventions on a case by case basis under the statutory standards of utility, novelty and unobviousness and would exclude in gross an entire area of technology from the protection of the Patent Act. The arguments advanced to support this exclusion are conjectural, based on disputed assertions of fact, and reflect the particular interests of petitioner and the hardware manufacturers who support him. Except in the case of atomic weapons, Congress has never excluded any area of technology from the Patent Act. The patent statute has been applied to countless new technologies as they developed and any departure from this legislative approach is a matter for Congress.

ARGUMENT

I. THE RESPONDENTS' INVENTION IS A PROPERLY CLAIMED MACHINE PROCESS WHICH MEETS THE REQUIREMENTS FOR PATENTABILITY UNDER THE STATUTE AND THE DECISIONS OF THIS COURT.

The invention made by respondents and claimed in their application is a particular method or process for use in a digital computer or other electrical data processing apparatus to convert electrical signals representing BCD numbers into electrical signals representing binary numbers equivalent in value. The claims at issue extend only to this particular machine process. They do not seek to embrace any underlying mathematical principle nor do they extend to any other method of converting electrical signals from BCD to binary form, whether by computer or otherwise.

In essence petitioner argues that respondents' process is not patentable subject matter because it is merely an idea, a mathematical principle, or a series of mental steps. The usefulness of the invented process is not questioned. Although petitioner seeks to color his arguments by references to the issues of novelty and obviousness, he does not directly and explicitly challenge the process on those grounds. Any such attack would be inadmissible because the issues of novelty or obviousness are not properly before the Court since they were not raised or relied on in the Patent Office, not argued in nor decided by the court below, and not presented by the petition for certiorari. See pp. 33-34, below. Petitioner's argument, therefore, should be considered on the assumption that the claimed process is useful, novel and not obvious.

A. Respondents' Claimed Invention Is a Machine Process Within the Meaning of the Patent Act.

Respondents' patent application shows that both claims at issue in this case are, on any reasonable construction, directed at a process to be performed within an electrical data processing apparatus such as the digital computer. This was the conclusion of the court below with respect to each of the claims (see p. 12, above) and the premise of the certiorari petition.[13] It is confirmed by an examination of their explicit language as well as the surrounding circumstances.

Claim 8 cannot legitimately be read as referring to anything other than a process performed uniquely in

[13] The certiorari petition (p. 2) as well as petitioner's brief on the merits (p. 2), described the question presented as involving the patentability of a BCD-to-binary conversion method for "use . . . in conventional general-purpose digital computers."

electrical circuitry typically found in a digital computer. The method claimed is one of converting "signals" which are the electrical impulses utilized by such computers. It is directed to the conversion of BCD signals to binary signals—a step particularly useful and necessary in the operation of computers. A "reentrant shift register," whose use is a central part of the described method, is a well-known piece of computer hardware. The steps described in claim 8 involve standard computer terminology: "storing . . . signals," "shifting signals," and masking and adding at fixed positions in the "register" (R. 142-43). Taking the claim as a whole, the lower court was clearly right in reading it to refer only to a machine-implemented process operating upon electrical signals.[18]

Claim 13 is broader than claim 8 for it is not confined to an apparatus utilizing a reentrant shift register. The claim is, however, confined to a process performed in an electrical data processing apparatus. This is true because the claim is stated in words peculiarly applicable to the automatic and mechanical operations of an electrical device ("testing" and "detected"); because of the technological fact that "the process of claim 13 has no practical use other than the more effective operation and utilization of a *machine* known as a digital computer" (441 F.2d at 688); and because of the application's description of the computer problems the invention was designed to solve and the circuitry and

[18] Petitioner's brief makes a half-hearted suggestion that the term "shift register" might comprehend a piece of paper with penciled notations on it but states that this is "immaterial" (Pet. Br. 25, n.26). The entire claim must be read as a whole and such a reading invokes computer operations at too many different points to permit any such reading.

program set forth in the specification to illustrate the process (R. 3-5, 9, 15).[14]

The respondents developed their invention as a machine process and that is the only object of their claims. Petitioner's argument to the contrary is directed primarily against claim 13. For the reasons stated above, we submit that there is no warrant for the broad construction that petitioner seeks to impose on claim 13. Furthermore, the arguments that petitioner addresses to claim 13 have no force as applied to claim 8; that claim unequivocally is confined to a process for electrically converting BCD signals into binary signals of equivalent value.

The process which respondents invented and have sought to patent—as contrasted with the mathematical relationship and technique they noted but did not claim—is a machine process. It thus is one of the types of invention that constitute statutory subject matter under the Patent Act (35 U.S.C. §§ 100(b), 101) and fall in the category of "Discoveries" relating to the "useful Arts" within the meaning of the constitutional clause (Art. I, Sec. 8, cl. 8).[15] The machine in this case is an electrical data processing machine and the process respondents have sought to patent occurs within the machine.

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[14] It is well settled that the specification may be used in construing the claims of the patent (*United States* v. *Adams*, 383 U.S. 39, 49 (1966)); and there is no reason to disregard technological realities in such construction, as petitioner's brief seems to suggest (Pet. Br. 24, n.24).

[15] It has long been settled that a machine process, like a metallurgical or chemical one, is patentable subject matter within the intent of Congress and the Constitution. *E.g.*, *Eames* v. *Andrews*, 122 U.S. 40 (1887); *Cochrane* v. *Deener*, 94 U.S. 780 (1877).

When this process is performed in accordance with the respondents' claims, various operations are performed within the data processing machine upon electrical signals. The operations include the transfer of signals from one portion of the apparatus to another, the detection and elimination of signals, and the incrementing of signals in a specific sequence of steps. At the completion of these operations, a sequence of signals arranged in one pattern has been converted into a sequence arranged in a different pattern producing a result that is highly useful in the operations of the machine.

Electrical signals are a no less proper work stuff for a process patent than flour, metal or glycerine, and a method of manipulating them is as legitimate subject matter for a patent as a method of purifying flour, expanding metal or extracting fat acids from glycerine. See p. 9, n. 9, above. The patenting of inventions involving the manipulation of electrical signals is not new or debatable. Such patents—including process as well as apparatus claims—were recognized in cases involving telegraphy, telephony, and radio.[16] The manipulation of electrical signals in digital computers for processing of data is a technological step forward but that is not a reason for treating it differently than a method of manipulating the electrical signals in telegraphy or radio equipment for purposes of communication. The patent laws, of course, embrace new fields of technology as they arise. The encouragement of such new developments is the major aim of the statute.

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[16] *O'Reilly* v. *Morse*, 56 U.S. (15 How.) 62 (1853); *The Telephone Cases*, 126 U.S. 1 (1888); *Mackay Radio & Telegraph Co.* v. *Radio Corp. of America*, 306 U.S. 86 (1939).

The electrical signals utilized in a data processing machine may be assigned numerical values, letter equivalents, names or any other meaning the user desires. The attribution of such meanings to the signals does not, however, render an apparatus or a process for manipulating these signals any the less a machine or a machine process. No one would suggest that an apparatus claim on an adding machine or digital computer was invalid merely because the apparatus contained gear wheels or electrical circuit components used in representing numbers whose ultimate significance is related to mathematical computations.[17] There is no basis in logic or authority for asserting that the attributed meanings preclude patentability in the case of a method claim but permit it in the case of a claim on apparatus. The patent sustained in *The Telephone Cases*, 126 U.S. 1 (1888), included a process claim for manipulating electrical signals whose ultimate use lay in their ability to transmit the human voice or other sounds.

Respondents, in order to render their process patentable, were not required to invent a new apparatus to utilize it so long as the process could be performed by some known means that renders it useful. Patentable processes may be and often are implemented with familiar apparatus elements. *E.g.*, *Smith* v. *Snow*, 394 U.S. 1 (1935); *Expanded Metal Co.* v. *Bradford*, 214

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[17] Indeed, fixed wired electrical circuits which perform the same basic task as respondents' process—conversion of BCD signals to binary signals—have been patented as apparatus in a large number of cases. For example, the Couleur patent (No. 3,026,035 issued on March 20, 1962) is an apparatus patent for manipulating electrical signals to effect BCD-to-binary conversion. The mathematical relationships that explain why it performs correctly are different than those relevant to respondents' process. See Appendix (pp. 6a-7a, below).

U.S. 366 (1909). Such processes may even involve merely a "new use" of a "known . . . machine." 35 U.S.C. § 100(b). See *Cochrane* v. *Deener*, 94 U.S. 780, 788 (1877). Apparatus disclosures in an application for a process claim are chiefly relevant in illustrating the operation of the process and confirming its utility. The utility of respondents' process is beyond question.[18]

B. The Patenting of Respondents' Invention Does Not Conflict With the Rule That an Abstract Idea or Mathematical Principle Is Not Patentable Subject Matter.

To support his position that respondents' patent claims should be rejected because they attempt to cover mathematical principles or formulae or mental steps, petitioner has intertwined several different arguments. He contends that the claims themselves show that respondents have sought to patent a mathematical theorem; that the claims fail to include "limitations" to a field of technology or end use which are alleged to be required as a matter of law; that the mathematical principle used by respondents in developing their invention does not "synergize" with the computer whose use is involved; and that the claims extend to unpatentable "mental processes." In the interests of clarity these various contentions should be disentangled and analyzed separately but whether considered separately or in their original entangled form they are without merit.

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[18] See generally *Brenner* v. *Manson*, 383 U.S. 519 (1966). Respondents' application disclosed a functional end use for the process (BCD-to-binary signal conversion); practical advantages of the new method over existing ones (see p. 10, above); illustrative apparatus capable of performing the process under appropriate programming (the relevant circuitry of the PBX control unit); and a specific application of the process to conversion of telephone dial signals (R. 7).

1. The assertion that respondents have sought to patent an idea (Pet. Br. 19-23) involves a confusion between the mathematical relationship and technique that respondents discovered and the useful and pragmatic appplication of the discovery in the invention that respondents have claimed in their patent application. Respondents, in the course of attempting to solve the problems created by limited circuitry and other practical constraints they faced, discovered a mathematical relationship not previously noted and derived a new mathematical technique for converting BCD numbers to binary numbers. The discovery assisted them in making the invention claimed in their application and it provides a theoretical explanation of its success. The mathematical relationship and technique are not, however, the invention claimed by respondents in their patent application.

What respondents did was to reduce their mathematical discovery to practical application in a machine process whose utility is beyond question. Respondents not only discerned the mathematical relationship and technique but they perceived how it could be applied for manipulating electrical signals in a computing apparatus in a way that would provide a solution to the particular hardware problems faced by respondents. See pp. 6-8, above. They then developed a process which allows conversion of BCD signals into binary signals to be performed in a computer without an adder device, without making the usual demands on storage capacity, and by a repetitive pattern of masking and incrementing which minimizes the likelihood of error. This sequence of discerning and reducing an abstract idea to a "pragmatic application" and "specific use" is what petitioner himself recognizes as the essence of a patentable invention (Pet. Br. 18).

Respondents have never sought to patent anything more than the invented process. Examination of their patent claims has already shown that the claims are directed to a process involving the manipulation of electrical signals performable only in a digital computer or other electrical data processing apparatus. The claims themselves thus refute petitioner's suggestion that the process claimed as invention is "nothing more than a sequence of mathematical steps" or mathematical "theorem" (Pet. Br. 20). That suggestion ignores the fact that respondents have reduced their mathematical discovery to practical application in an electrical machine process whose utility is beyond question, and have limited their claims to that machine process.

Certainly petitioner cannot deny respondents a patent on the ground that their invention is derived from or explained by an idea that may not itself be the subject of a patent claim. Every invention involves the application of abstract principles or natural laws to a specific situation, and this is equally true whether the invention utilizes laws of physics in implementing a new smelter process, implements the laws of chemistry to create a new material, or applies the laws of mathematics for development of a new process for manipulating electrical signals in data processing apparatus. This Court has repeatedly recognized that while phenomena of nature, scientific principles and natural laws may not be patented, the specific and pragmatic application or use of such phenomena, principles or laws may give rise to a patentable invention.[19]

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[19] *Mackay Radio & Telegraph Co.* v. *Radio Corp. of America*, 306 U.S. 86, 94 (1939); *The Telephone Cases*, 126 U.S. 1, 532-33 (1888); *DeForest Radio Co.* v. *General Electric Co.*, 283 U.S. 664, 684-85 (1931); *Smith* v. *Snow*, 294 U.S. 1 (1935).

Respondents' application for a patent on such a specific and pragmatic use no more "monopolizes" the underlying idea than does any other patent. Every patent restricts the application of the underlying scientific or mathematical truth in the identical method or apparatus covered by the patent, in exchange for the benefits that the patent system affords. See pp. 42-48, below. But the restrictive effect of the patent is confined to the use of the scientific principle or mathematical truth as applied in the particular method or apparatus described in the patent claims. This does not mean that the patent covers the scientific or mathematical truth itself and thereby removes it from the public domain. Others are free to use it in any way that does not duplicate the specific process or apparatus covered by the patent.[20]

In this case, respondents have not sought to patent the mathematical truths they discovered. They have claimed only a particular method derived from their discovery of those truths, *i.e.*, a series of specific steps for the conversion of BCD signals into binary signals in an electrical data processing apparatus. The underlying truths may assist in disclosing other new mathematical techniques—*e.g.*, a method for converting binary numbers to BCD numbers—and respondents' own technique may prove useful in the operation of some machine or apparatus other than an electrical data processor. A fast developing technology may well develop other substantially different means for implementing the technique that will have wide practical ap-

[20] It should also be remembered that the use of a patented article or process for experimental or instructional purposes does not constitute infringement. *Kaz Mfg. Co.* v. *Chesebrough-Ponds, Inc.*, 317 F.2d 679 (2d Cir. 1963); *Chesterfield* v. *United States*, 159 F.Supp. 371 (Ct. Cl. 1958).

plication, such as an apparatus using film, hydraulics or non-electrical machine parts. Respondents' claims will not in any way restrict the use of the mathematical technique in any apparatus other than an electrical data processing apparatus. The claims are, therefore, not equivalent in any sense to a claim of the mathematical technique without regard to the purpose or means of its implementation.

Even if it is assumed to be unlikely that in the future other practical apparatus for implementing the technique will be developed it does not follow that the claims are invalid. In *The Telephone Cases,* this Court held that the claim in issue could not be invalidated by an argument that the method described might extend to all practical means of using electricity to transmit speech.[21] In terms of its practical importance the breadth of the claim sustained by the Court in that case was far greater than the breadth of respondents' claims here. See pp. 28-29, below.

2. Petitioner's brief asserts principally that the "decisions of this Court" show that a process such as that sought to be patented here is only valid when it has limitations "both" confining it to "a particular type of apparatus or hardware" and confining "the application of the method to a specified field of technology" (Pet. Br. 23). Elsewhere petitioner suggests that the latter restriction must confine the invention to a partic-

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[21] The Court stated:

> "It may be that electricity cannot be used at all for the transmission of speech except in the way Bell has discovered, and that therefore, practically, his patent gives him its exclusive use for that purpose, but that does not make his claim one for the use of electricity distinct from the particular process with which it is connected in his patent. It will, if true, show more clearly the great importance of his discovery, but it will not invalidate his patent." 126 U.S. at 535.

ular end use within a field of technology, such as converting telephone dial signals from one form to another.[22]

This entire line of argument is founded on a misstatement of the applicable law. There is no declared general rule that a process claim which properly describes the steps of a novel and unobvious process useful in the technological arts must necessarily limit the invention to a preferred apparatus on which those steps can be performed, to one field of technology in which they find their most useful application, or to a particular purpose or end use to which the invention must be put. Nevertheless, respondents' claims here meet all of these requirments and petitioner's argument is in substance simply an assertion that the respondents' claims should have recited a different apparatus, a more limited field of technology, and a narrower end use.

The suggestion that a process claim must necessarily include an apparatus limitation is not consistent with the decisions of this Court. As long ago as *Cochrane* v. *Deener*, 94 U.S. 780, 787 (1877), this Court declared: "That a process may be patentable, irrespective of the particular form of the instrumentalities used, cannot be disputed." Nevertheless, the process claimed by respondents in this case is confined to use in electrical data processing equipment so the peti-

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[22] Petitioner employs the "end use" phrasing in its summary of argument where the claims are characterized as being "without limitation as to end use or apparatus" (Pet. Br. 15). In the argument itself, petitioner varies the alleged rule to one requiring limitations confining the process to "application . . . to a specified field of technology" and "to a particular type of apparatus" (Pet. Br. 23).

tioner's own standard is satisfied.[23] No reason or authority is provided why respondents' claims should be confined to some narrower or different class of apparatus.

Petitioner's further supposed requirements that the process be restricted to a particular field of technology and a specific end use are also met in this instance. Respondents' process obviously does fall within a field of technology—electrical data processing—which is a growing field but hardly larger than others (*e.g.*, medicinal drugs, internal combustion engines) where patents are regularly issued. The invented process also has a specific end use, *i.e.*, conversion of BCD signals to binary signals. Petitioner's own classification manual recognizes radix conversion as an appropriate function for an invention. See p. 6, n. 7, above. Thus, what petitioner seems to be arguing is that respondents' process is not patentable unless confined in application to some *other* field of technology such as telephony or narrowed further to some particular end use within the field such as converting telephone dial signals. See Pet. Br. 3, 23.

While the petitioner asserts that these requirements "emerge" from two decisions (Pet. Br. 23)—*O'Reilly* v. *Morse*, 56 U.S. (15 How.) 62 (1853) and *The Tele-*

[23] While petitioner's brief asserts that respondents' "claims" were not limited to any "particular apparatus" (Pet. Br. 3), in the same passage it seems to concede that the claims are confined to "any use of the claimed method in a general purpose digital computer" which is clearly an apparatus restriction. The petitioner elsewhere recognizes that confining claim 8 to digital computers is a restriction on apparatus (Pet. Br. 16). Thus, the statement that no apparatus restriction exists is apparently addressed only to claim 13 and there depends on the petitioner's unduly broad reading of that claim.

phone Cases, 126 U.S. 1 (1888)—neither lends any support to the alleged rule of law. Contrary to petitioner's reading, neither case even went so far as to hold that apparatus limitations are essential to machine process claims, although that point is not significant here since respondents' claims are confined to a type of apparatus.[24] Stretching *The Telephone Cases* still further, petitioner reads that decision as requiring that machine process claims embody "use limitations indicating a particular field of art" and it asserts that Bell's "claimed use was confined to telephone systems . . ." (Pet. Br. 23). Telephony, however, was obviously not the end use of Bell's invention; that invention *was* telephony (see p. 29, n. 26 below) and the end use of the telephone is any of the many purposes to which telephones may be put in countless fields of endeavor.[25]

Nothing in the language of either of the cases upholding telegraph and telephone patents ever suggested that the patentee was confined to any end use

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[24] In *Morse* the Court upheld an apparatus claim while striking down a claim so general that it described neither an apparatus nor a process but embraced any use of electro-magnetism for long distance marking or printing, whatever the method or apparatus employed. See 56 U.S. (15 How.) at 112. In *The Telephone Cases*, the Court expressly upheld both an apparatus claim and a method claim which was not confined to any particular apparatus; while two different devices were mentioned in the specification to establish utility and one was expressly claimed, the Court expressly emphasized that the patent was "not to be confined to the mere means [Bell] improvised to prove the reality of his conception." 126 U.S. at 539.

[25] On petitioner's legal theory the Bell patent should have been held invalid because it did not restrict the claimed invention of telephony to use of the telephone for certain of the many specific end uses of which it was capable as, for example, in the operation of railroad trains, the verifying of credit cards or the withdrawing of cash from banks (Pet. Br. 21).

narrower than communication. Whether such telegraph or telephone communication is applied to serve one field of technology (*e.g.*, operation of railroads) or thousands of them and whether it is put to one end use within a field (cancelling railroad reservations) or thousands of them does not make the patent more or less valid. Indeed, an entire existing subclass of patents—subclass 155 of class 235—has the same end use as respondents' invention (see p. 6, above) and radix conversion in the data processing field is a comparatively narrow end use. The breadth of respondents' claims is insignificant compared to the claims sanctioned in both of the cases cited by the petitioner.[26]

3. Petitioner appears to argue that the restriction to electrical data processing apparatus that demonstrably exists here cannot be considered in determining whether respondents have developed a patentable invention. Petitioner states that there is no contention that the "mathematical principle respondents claim synergizes with the computer" (Pet. Br. 26), *i.e.*, enhances the operation of the computer. Therefore, it is argued, restriction of the invention to computers is merely the assertion that a mathematical formula—which might be utilized in any apparatus or in the human mind—is in this instance fortuitously directed to use in a computer.

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[26] For example, in *The Telephone Cases* the Court in describing Bell's invention stated: "What Bell claims is the art of creating changes of intensity in a continuous current of electricity, exactly corresponding to the changes of density in the air caused by the vibrations which accompany vocal or other sounds, and of using that electrical condition thus created for sending and receiving articulate speech telegraphically." 126 U.S. at 533-34.

Respondents have not claimed the mathematical principle but rather a machine process developed with the aid of that principle and the process does indeed synergize with and enhance the operations of the computer. The patent application describes at length the particular hardware problems faced by respondents and how their process is a solution to those problems in several ways. In particular, the process allows BCD-to-binary signal conversion to be performed in a computer with fewer hardware devices (such as the adder), less demand on computer storage capacity, and with fewer errors. It is precisely because respondents' method of processing signals does have special utility in computers that it is clearly a useful machine process.

The citations that accompany the synergism argument (Pet. Br. 26) have nothing to do with the question of when an apparatus limitation is requisite or sufficient to reduce an idea to a patentable process. Each of the cases involved a dispute whether a combination of known apparatus elements into a new form was so new and unobvious as to constitute invention.[27] The citations and petitioner's accompanying statement that there must be "novel and unconventional cooperation" between the mathematics and the computer suggest that petitioner is really contending that respondents' process does not meet the statutory standards of novelty and unobviousness. Any such argument is neither presented by this case nor is it supported by the record. See pp. 32-38, below.

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[27] For example, in *Anderson's-Black Rock, Inc.* v. *Pavement Co.*, 396 U.S. 57 (1969), the Court held that the combination on one chassis of a heater, spreader, and other devices for blacktopping a road was not unobvious under the standard laid down in Section 103.

4. Petitioner asserts that the lower court's decision impairs a doctrine, previously accepted by the lower court and the Patent Office, that "purely mental steps do not form a process which falls within the scope of patentability as defined by statute" (Pet. Br. 29). This assertion is essentially an argument that claim 13 is overbroad because it might be read to claim both a machine process and a process relying on mental steps aided by pencil and paper or poker chips used as recording instruments (Pet. Br. 30). The argument must be confined to claim 13 because there is no reading of claim 8 that could extend it beyond its intended application, *i.e.*, to a process carried on entirely within a digital computer or other electrical computing apparatus.

Claim 8 by its own terms reads only upon a series of steps that cannot be performed oustide the confines of such an apparatus. Even if the claim were read in total isolation from the descriptions in the patent application, its steps specified "converting signals," "storing . . . signals," the use of a "reentrant shift register," the "shifting of signals," and "masking" and adding at specific "positions" of the register. This language describes nothing other than manipulations within an electrical data processing apparatus. Accordingly, there is no way in which claim 8 could be offensive to any doctrine concerning mental steps.

A proper construction of claim 13 also confines it only to the processing of electrical signals in a digital computer or other electrical data processing apparatus. See pp. 17-18, above. Even if that claim were construed to extend to other types of machinery not employing electrical signals, machinery does not perform a series of mental steps. Respondents have never sought to

patent the performance of any steps by a human being, with pencil and paper, poker chips, or any other such recording device, and the lower court has not sanctioned any such claim. Thus the questions of how far mental steps might be involved in such an operation and what involvement of the human mind in a process suffices to prevent patentability are essentially moot points.

Needless to say, any doctrine relating to "purely mental steps" has no application to the operations that occur within a computer. Computers do not "think" except by an abuse of metaphor; they are made to conduct electrical signals, just as a light bulb does, in patterns and for purposes useful to human beings. When the operation of a computer is followed step by step through performance of a specific function—such as conversion of a BCD sequence of signals into equivalent binary signals in accordance with respondents' process—it becomes apparent that the operations are as physical and inanimate as the operations of a telephone or an electrical dishwasher. See Appendix (pp. 8a-13a, below).

C. Arguments Directed to Novelty, Obviousness and Inherent Function Do Not Justify Reversal of the Decision Below.

Petitioner purports to rely primarily upon the contentions that the claims in issue are unpatentable because they cover "mental processes" or "scientific principles" but throughout his brief he embroiders these contentions with assertions, assumptions and insinuations that the claims are invalid because they lack novelty and are obvious or because they merely cover the "inherent function" of a machine (*e.g.*, Pet. Br. 20, 26, 28). Certain of the amici supporting the petitioner even more explicitly attempt to rely upon the

latter grounds of invalidity.[29] These objections to the claims will not suffice either to cure the infirmities in petitioner's other arguments or as independent grounds for reversing the judgment below. The objections raise issues that are not properly before the Court and in any event the objections are without merit.

In the Patent Office no prior art was cited against the two claims at issue and the Patent Office did not reject these claims on the ground that they covered subject matter that was not novel under Section 102 or that was obvious under the standard of Section 103. On the contrary, the Patent Office based its rejection of the claims on the sole and explicit ground that they related to "subject matter not embraced by 35 U.S.C. 101 in that they set forth 'mental processes' and 'mathematical steps,' neither being an 'art' " (R. 137). Accordingly, the court below noted that as to the claims here in issue "no prior art is cited and no question is raised as to utility, novelty, or unobviousness." 441 F.2d at 684. Quite properly, therefore, the court below did not consider or decide those questions.

Although at one stage the Patent Office Examiner objected to respondents' claims on the ground that they covered the inherent function of a machine (R. 29), he thereafter withdrew that objection and in their final rejection of claims 8 and 13, neither the Examiner (R. 135) nor the Patent Office Board of Appeals (R. 138) relied in any degree, either expressly or by implication, on the doctrine of inherent function. The point was not argued by the Patent Office in the court below and that court did not discuss or decide any questions relating to inherent function.

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[29] *E.g.*, IBM Br. 23-25 (inherent function); Honeywell Br. 15-17 (obviousness); Burroughs Br. 8-9, 1a-11a (obviousness).

Similarly the petition for certiorari did not seek review on questions of novelty, obviousness or inherent function. The petition sought review solely on the precise issue on which the Patent Office based its rejection and which was decided by the court below. Thus the petition asserted that the process here involved "is nothing more than an arrangement of arithmetical calculations" (Pet. 8); that "ideas—scientific principles, mental processes, and abstract intellectual concepts"—are not patentable subject matter (Pet. 8-9); and that "this Court has repeatedly ruled that a scientific principle, rule, formula or mathematical expression is not a patentable process, *regardless of the novelty or the importance of the discovery*" (Pet. 9). (Emphasis supplied.)

The certiorari petition did not cite Section 102 which concerns novelty or Section 103 which establishes the standard of non-obviousness (see Pet. 2), and it made no reference to the doctrine of inherent function. Read as a whole the petition shows that petitioner sought certiorari to present the basic question whether computer programs could ever be patented and not to redress mistaken applications of the novelty or obviousness standards as applied to particular claims. In these circumstances we submit that for present purposes the claims here at issue should be considered on the assumption that they meet the requirements of novelty and non-obviousness and are not invalid under the inherent function doctrine.[29]

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[29] Generally this Court will not consider issues not presented in the petition for certiorari or not presented and argued in the court below. *General Talking Pictures Corp.* v. *Western Electric Co.*, 304 U.S. 175, 177-78 (1938) (issue of anticipation and lack of invention not presented by petition); *Neely* v. *Eby Construction Co.*, 386 U.S. 317, 330 (1967). If the judgment below

Even if the novelty and non-obviousness of respondents' invention were open to attack in this Court, the arguments that petitioner addresses to these questions are without merit. Petitioner's suggestion that the claims here in issue lack novelty and are obvious rests upon the assertion that respondents "seek a patent grant on a theorem" that follows "automatically" from the mathematical definitions of binary, decimal and BCD numbers and from the axioms of binary addition and multiplication and that the theorem itself is "elementary" (Pet. Br. 20). The "theorem," however, is not the invention claimed by respondents and there is no proof of any kind that either the theorem or the invention claimed is elementary.

Here respondents discerned a previously unnoted mathematical relationship and derived a new mathematical technique for converting BCD numbers to binary form; they perceived that the technique could be significant and useful in devising a process for accomplishing BCD-to-binary signal conversion in an electrical data processing apparatus; and finally, they devised such a process which not only is a practical application of the technique but actually enhances the operation of the apparatus. As we have shown above the invention claimed is the process and not the mathematical relationship or technique used in devising the process. To establish that the claims in issue lack novelty and are obvious, petitioner must establish that respondents' invention was anticipated by the prior art or was so slight an advance that the invention "as a whole" would have been "obvious at the time the in-

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should be affirmed, the case will proceed in the Patent Office pursuant to the lower court's judgment and the Patent Office will not be precluded from further considering issues relating to novelty, obviousness and inherent function before any patent issue.

vention was made" to one with ordinary skill in the relevant art. 35 U.S.C. § § 102-03.[30]

Nothing in the record in the Patent Office or in petitioner's brief provides even a colorable showing of this kind. Although the conversion of BCD signals to binary signals had for years been the subject of investigation in the computer field and even though over 75 patents covering means of conversion between such signals have been issued (see p. 6, n. 7, above), the Patent Office was not at any time able to cite any prior art against the claims. See *United States* v. *Adams*, 383 U.S. 39, 52 (1966). Thus there was no citation of any prior art that even suggested that the discovery of the mathematical relationship used in respondents' process was "elementary." Certainly there was no evidence that the invention taken as a whole—starting with the recognition of the mathematics and concluding with the invented process—lacked novelty or was obvious.

Amicus IBM also attacks the novelty and unobviousness of respondents' invention by arguing that respondents' discovery of a "mathematical principle" must be disregarded because it is unpatentable and that the subsequent application of the principle to electrical data processing was a "simple step" that does not rise to the level of "inventive dignity" (IBM Br. 23). IBM re-

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[30] This statutory language, and the cases that have construed it, make clear that this determination cannot proceed by fragmenting the invention into parts which are themselves simple nor can it be based on a hindsight evaluation made easy by the very knowledge the inventor has contributed. See *United States* v. *Adams*, 383 U.S. 39, 51-52 (1966); *Walt Disney Productions* v. *Fred A. Niles Communications Center, Inc.*, 369 F.2d 230, 234 (7th Cir. 1966); *In re Sponnoble*, 405 F.2d 578, 585 (C.C.P.A. 1969).

lies principally upon the *Funk Bros. Seed Co.* v. *Kalo Inoculant Co.*, 333 U.S. 127 (1948), where the Court rejected claims relating to a product that merely combined in a single package certain strains of known bacteria that the inventor had found to be compatible. The combination added nothing to the natural physical qualities or efficacy of the individual strains and on this ground the Court held that a product patent could not be sustained.[31] It stated that it was not passing on any claim for a process useful in selecting particular strains of bacteria that might be compatibly combined. 333 U.S. at 130.

Here respondents do not claim any pre-existing physical materials as a product but instead seek a patent on a process which achieves a function by means that did not pre-exist in nature and had not been anticipated by prior art. See *Waxham* v. *Smith*, 294 U.S. 20, 32 (1935). Respondents did not only discover an unnoted mathematical relationship between positional values in BCD notations and those in binary notations, but they employed their discovery to invent a machine process, *i.e.*, a specific set of steps for converting BCD signals into binary signals in an electrical data processing apparatus. This process did not exist either in a purely physical sense or in the mind of man until it was conceived and implemented by respondents. In these circumstances the *Funk* decision has no appli-

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[31] Thus the Court emphasized that the combination of species "produces no new bacteria, no change in the six species of bacteria, and no enlargement of the range of their utility. Each species has the same effect it always had. The bacteria perform in their natural way. Their use in combination does not improve in any way their natural functioning. They serve the ends nature originally provided and act quite independently of any effort of the patentee." 333 U.S. at 131.

cation.[32] There is, moreover, no basis for asserting that the reduction of any underlying mathematic principle here involved to the claimed machine process was itself obvious in light of the prior art.

Petitioner's reference to the doctrine of inherent function involves misconceptions of the decisions of this Court and of the claims here in issue (Pet. Br. 28; see also IBM Br. 23-25). What the decisions of this Court show is that the mere "result" or "effect" of a machine is not a method and hence is not patentable so that if a claim that purports to define a method is found in fact to claim the result or effect of a machine's operation it is invalid. On the other hand, if the claim defines the acts or steps that lead to the desired result or effect it is a valid process claim, assuming that the other standards of patentability are satisfied.[33] The inherent function doctrine, properly understood, was designed to preclude process claims which by claiming broadly the effect of a machine's operation attempted to extend the patent monopoly to other means of accomplishing the same result which the inventor had

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[32] To read *Funk* as broadly precluding consideration of the totality of an inventor's contribution including relevant aspects that may not themselves be patentable would make it inconsistent with the reasoning of this Court in cases both preceding and following *Funk*. See, *e.g.*, *Eibel* v. *Paper Co.*, 261 U.S. 45, 66-68 (1923); *United States* v. *Adams*, 383 U.S. 39, 52 (1966).

[33] The earlier decisions of this Court dealing with process patents show that the doctrine of inherent function was directed against claims on effects masquerading as claims on process. Thus in *Expanded Metal Co.* v. *Bradford*, 214 U.S. 366, 383 (1909), this Court, in discussing the doctrine, equated "the mere function" of a machine to the "effect of the operation of a machine." See also *Cochrane* v. *Deener*, 94 U.S. 780, 787-88 (1877); *Corning* v. *Burden*, 56 U.S. (15 How.) 252, 268 (1883).

not described or even conceived and which he could not therefore properly claim as his invention.[34]

Any process implemented by machine must, if the process works, employ a machine "inherently" capable of performing the required "function." Plainly this cannot preclude patentability of the process so long as the inventor limits himself to claiming the process he invented and not every other means of securing the same result. The Court made this clear in *Waxham* v. *Smith,* 294 U.S. 20 (1935), which upheld a process claim for incubating eggs. The process involved the use of an incubator, racks, chains and other apparatus all of which merely performed their mechanical functions. The Court rejected an argument that the claim was an improper attempt to patent a function performed by the apparatus stating: "But the function which a machine performs, here the hatching of eggs, is to be distinguished from the means by which that performance is secured." 294 U.S. at 21.

In the present case the claims in issue describe acts or steps that result in the desired function or effect. They do not purport to cover broadly the effect itself, *i.e.,* the conversion of BCD signals to binary signals,

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[34] The principal decisions in this Court bearing on the inherent function doctrine are discussed and analyzed in *In re Tarczy-Hornoch,* 397 F.2d 856 (C.C.P.A. 1968). Contrary to the suggestion of petitioner (Pet. Br. 28) and of IBM (Br. 25, n.31) the Court of Customs and Patent Appeals in that case did not reject any rule laid down by this Court in its decisions; it held that other lower federal courts had misinterpreted those decisions by requiring a showing that a claimed machine process could be performed in some manual fashion or by apparatus other than that disclosed in the application. 397 F.2d at 864, 866. Whether *Tarczy-Hornoch* was correct or not is irrelevant here since respondents did show their process could be performed in more than one electrical apparatus (R. 15, 39).

by attempting to claim all methods or processes for achieving that effect in a computer. The claims are confined to the particular acts or steps that they set forth and leave open the conversion of BCD signals to binary signals in a computer by any and all processes except that specifically set forth. The fact that the acts or steps described in the claims are intended to cause a digital computer or PBX control unit to perform functions of which it is capable does not bring the claims within the scope of the "inherent function" doctrine. It was equally true that the method patent in *Waxham* was directed to the performance of functions that the apparatus was designed and constructed to perform. The decisive point here, as in *Waxham,* is that the claims set forth all of the steps necessary to secure a result by a method which is novel, useful and non-obvious.[35]

II. THE VARIOUS POLICY ARGUMENTS THAT COMPUTER PROCESSES AND PROGRAMS AS A CLASS SHOULD NOT BE PATENTABLE ARE UNSOUND AND ARE NOT A VALID GROUND FOR DENYING PATENT PROTECTION TO RESPONDENTS' INVENTION.

Petitioner and the amici who support him advance a variety of policy arguments that they assert require reversal of the judgment below. In large part those arguments assert opinions and preferences which we believe are erroneous and which, in any event, rest upon assumptions of fact that have not been examined in

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[35] There is a basic incongruity in any attempt to apply the doctrine of inherent function to a programmable electrical data processing apparatus. Such a machine has no inherent function apart from the execution of directions which cause it to perform certain mechanical operations. Without directions, it is inert. Respondents' claims do not preempt any inherent function of the machine. On the contrary they set forth a process that gives the machine a function that it would not otherwise possess.

this or any other judicial proceeding and have never been scrutinized or accepted by Congress. They represent an invitation to this Court to bend the particular standards of patentability established by the statute in order to accommodate the administrative convenience of petitioner and the private interests of the computer manufacturers who support him.[36]

A remarkable characteristic of these arguments is that they seek a sweeping declaration that would deny patentability to an entire class of inventions—computer processes and programs—without examining particular applications and without regard to the utility, novelty and unobviousness of the individual inventions.[37] Yet Congress, with a single exception (see p. 64, below), has not excluded fields of technology from the statute but has designed standards generally applicable to all inventions on a case by case basis. The policy arguments seeking a broad scale exclusion from the statute are therefore arguments more appropriately addressed to Congress than to this Court and they are, in any case, without merit.

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[36] Three of the amici supporting the petitioner—IBM, Honeywell, and Burroughs Corp.—are major manufacturers of computers and related hardware, while the Business Equipment Manufacturers Association is a trade association whose members include "the nation's leading manufacturers of computers and computer-related equipment" (BEMA Br. 2).

[37] The phrase "computer processes and programs" is used here to embrace processes such as that of respondents, devised principally for use in a special purpose electrical data processing apparatus, and those—sometimes loosely described as "programs"—devised principally for use in general purpose digital computers. In either instance it is the machine process that may be patentable; neither respondents nor any other participant in this case has suggested that the written or otherwise recorded description of the process can be patented. See p. 9, above.

A. The Patenting of Inventions Such as That of Respondents Will Serve the Normal Ends of the Patent System.

The various policy arguments of petitioner and amici are notably for their repeated, and sometimes explicit, refusal to give due consideration and weight to the long established congressional policy in favor of providing patent protection for new, useful and unobvious inventions. Thus, petitioner, in urging a construction of the statute that would deny all patents in an entire field of technology, suggests that patents are antithetical to our national policy and that administrative convenience is a ground for denying an otherwise proper patent application (Pet. Br. 32-33). The same philosophy permeates the briefs of amici.

The patent system was sanctioned by the framers of the Constitution, established by the first Congress (1 Stat. 109) and has been maintained with its basic elements intact virtually throughout the nation's history. The present statute is a considered determination by Congress that every "process, machine, manufacture, or composition of matter" which meets the statutory standards of novelty, usefulness and non-obviousness should be given patent protection. That policy has thus been an integral part of the Federal Government's approach to technology for almost two centuries and it has been applied to new technologies as they have developed. It cannot be brushed aside or ignored as petitioner and amici seek to do.

The reasons that underlie the policy of patent protection are directly relevant here. It is elementary that the patent system has two basic purposes. First, it provides an incentive to the inventor to produce, and the investors to develop, new inventions and thus encourages both technological advances and the wider use

of new developments; and, second, by requiring the patentee to disclose his invention to the public it widely disseminates knowledge of new scientific discoveries and technological advances and thereby stimulates additional research, development and invention.[38]

The close relationship between the two general purposes of the patent system is apparent. Without patent protection for a limited period of time, the technological advance if disclosed could be utilized freely by anyone, yet the incentive to invent and develop could hardly be maintained if subsequent users could employ and profit from the invention without recompensing those who made the invention and ran the investment risk of its development.[39] Inventors may be able to protect the fruits of their efforts in one degree or another by cloaking the invention with secrecy or curtailing its potential use. While that may preserve some incentive to invent and develop, it does so by depriving the public of the benefits that flow to it from patenting: "full disclosure of the patented invention and its dedication to the public on the expiration of the patent."

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[38] *Scott Paper Co.* v. *Marcalus Co.*, 326 U.S. 249, 255 (1945); *United States* v. *Dubilier Condenser Corp.*, 289 U.S. 178, 186-87 (1933); *Grant* v. *Raymond*, 31 U.S. (6 Pet.) 218, 241-42 (1832); *Report of the President's Commission on the Patent System* 1-3 (1966), reprinted in S. Doc. No. 5, 90th Cong., 1st Sess. (1967).

[39] See W. Leontief, *Essays in Economics* 216-22 (1966): "[W]ho would pay for a good which, once it has been produced, becomes available to everyone in an unlimited amount? Why not wait until someone else pays for it or invests in its production and then have a free ride? . . . The patent, the copyright, and the licensing laws take care of this. They provide the quantity dimensions for objects which intrinsically have none and thus make it possible for private enterprise" to engage in invention as in any other productive activity. *Id.* at 218.

Scott Paper Co. v. *Marcalus Co.*, 326 U.S. 249, 255 (1945).

Measured against the purposes of the Patent Act, computer processes and programs which are useful, novel and unobvious are in exactly the same category as any other inventive advance. For "the general policies behind the patent system apply to computer programs as well." Comment, 54 *Cornell L. Rev.* 586, 602 (1969). "Software," the term used in the computer industry to embrace computer processes, programs, and related materials, has as much need for patent protection as the computer hardware with which the software cooperates. The lack of assured protection to date, because of petitioner's opposition, has produced the very ills the patent system was intended to prevent.

Software's need for patent protection is obvious. On the one hand, thousands and even millions of dollars may be expended in developing a single computer process or program, just as such sums are often expended in developing a new chemical process or machine apparatus.[40] On the other hand, it is not likely to cost more than a few dollars—perhaps $50 for an entire lengthy program—to copy or duplicate a process description or computer program which can then be converted to the copier's use in the absence of patent protection. Copyright, for reasons explained below, cannot even if available provide meaningful protection

[40] See Comment, 54 *Cornell L. Rev.* 586, 589 & n. 17 (1969). A single program may involve thousands of man hours. *Id.* Much of a program's development cost may be expended on routine operations. Yet very substantial time and expense may be spent in developing an aspect of the program or a basic method that, although it may be briefly described, is the essential inventive advance and may be central to the entire program.

for an inventive process or program. See p. 48, below. Thus, if real stimulation is to be provided for the further development and dissemination of computer processes and programs, there is no adequate substitute for the protection provided by the Patent Act.

The argument for protection is not answered by suggestions that production of new programs has been adequate in the past despite the legal uncertainty of patent protection (*e.g.*, BEMA Br. 10). There is a widely held view that there are deficiencies in software production, and that its development has lagged far behind the hardware side of the computer business.[41] Moreover, the patent system is designed to produce more and better invention, whatever the current rate of technological growth.

The main beneficiaries of patent protection are, of course, numerous software companies, many of whom are small independent enterprises, for whom programming is the central line of business. Computer programming is in fact a field where basic advances may still reasonably be expected not only from small companies but from the private individual inventor possessing expert skill. Many of these companies recognize the need for and the advantages of patent protection for computer processes and programs. See, *e.g.*, *Bus. Week*, Oct. 21, 1967, p. 178. Indeed, a principal trade association of software companies including over thirty such companies—the Association of Data Processing Service Organizations-Software Products and

[41] See, *e.g.*, Statement of Dr. Ruth M. Davis, *Hearings of the Government Activities Subcommittee of the House Committee on Government Operations*, May 16, 1972, pp. 12-13; Bender, "Computer Programs: Should They Be Patentable?," 68 *Colum. L. Rev.* 241, 247-48 (1968); *Electronic News*, May 8, 1967, p. 36.

Service Section—has filed a brief amicus curiae supporting affirmance of the judgment below in this case.[42]

The second general function of the patent system is to discourage secrecy and promote the dissemination of new inventions and the ideas that underlie them. In the absence of patent protection, the inventor has a strong interest in limiting the knowledge of his invention by contract, trade secret methods, and other means that prevent the invention from being as widely known and used as it might otherwise be. To obtain a patent, however, the inventor must make a public record of his invention in the patent application which must include a description that teaches the invention to others. 35 U.S.C. § 112. This disclosure is the price the patent system extracts for the time-limited patent that it affords the inventor. Where disclosure is made through the patent system, others may usually use the invention under license and, when the patent expires, without charge. Unnecessary and wasteful duplication of efforts directed to the same problem may be avoided. Others may build upon the patented invention to develop improvements that are themselves patentable. Most importantly, the underlying insight or perception of the invention is made available for whatever other applications may be made of it by others and the universe of knowledge is expanded.

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[42] In a separate amicus brief urging affirmance, another software company, Whitlow Computer Systems, Inc., explains (p.2, n. 2):

> "It has been Whitlow's experience that the financial community views investment in the software industry with justifiable apprehension because it is not certain whether computer programs will be accorded the benefit of the patent system. Whitlow believes that many potential investors refused to invest in Whitlow simply because it could give no assurance that its computer programs will be held to be patentable subject matter."

This independent and important benefit of the patent system may be illustrated by reference to the present case. Bell Telephone Laboratories, Inc., the assignee of the patent application here involved, is quite unlike the usual software manufacturer since it is not engaged in the business of selling computer processes and programs to the general public, its patents are freely licensed, and it has independent incentives to invent not applicable in the normal case, *i.e.*, the use of the developed process in the telephone system.[43] The primary interest of Bell Telephone Laboratories, which is essentially a research organization, lies in the public disclosure of new developments in the field that will result if processes and programs are patentable. Then Bell Telephone Laboratories as well as other developers of software will have an opportunity to seek licenses to use the processes and programs that might otherwise be cloaked in secrecy and the disclosure of the concepts and ideas that underlie patented processes and programs will assist Bell Telephone Laboratories and others in making new and additional developments in the field.

In an attempt to protect their proprietary interests, many software producers have resorted to a variety of devices and practices to maintain the secrecy of

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[43] All patents of Bell Telephone Laboratories are subject to compulsory licensing at reasonable royalties by virtue of the provisions of a consent judgment entered in *United States* v. *Western Electric Co.*, 1956 CCH Trade Cases ¶ 68,246, pp. 71,139-40 (D. N.J. 1956). Virtually thousands of licenses have been issued pursuant to that decree.

Various of the amici supporting the petitioner here—see, *e.g.*, IBM Br. 2, n.1; Burroughs Br. 2—already have licenses that will automatically permit them to use the processes involved in this case should a patent issue.

their new developments including the usual trade secret measures, restrictive license agreements, and coding of their programs to permit use without knowledge of the underlying method.[44] It is generally recognized that this secrecy has wasted time and scarce resources in duplicative development and has essentially retarded progress. Necessarily, "if the only available form of protection is secrecy . . . program hoarding will reduce the utility of new programs and choke off the sort of technical dialogue that nourishes the art." Bender, *supra*, at 246. If patent protection is available, however, the software manufacturer has every reason to make and publicize fundamental improvements in programming whose cost can be repaid by licensing them to a number of different users.

Adequate protection of new inventions in this field cannot be furnished by copyright. Even assuming that computer processes and programs are protected by the Copyright Act, the copyright and patent laws aim at protecting quite different interests. Only the *form* of expression is protected by copyright,[45] and use of the described process or method that would be protected under the Patent Act is not covered by copyright. Whether the copyright laws apply at all to written descriptions of computer processes or programs is

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[44] Bender, "Computer Programs: Should They Be Patentable?," 68 *Colum. L. Rev.* 241, 245-46 (1968); Kohler & Moshman, "Patent Protection for Computer Software: Implications for the Industry," 12 *Idea* 1109, 1115 (1969). For example, IBM's standard License Agreement for IBM Program Products used in licensing its software provides that the licensee may not make the software available to others ("Protection and Security" clause) and it restricts the number of copies the licensee may make for its own use ("Permission to Copy" clause).

[45] *Baker* v. *Selden*, 101 U.S. 99, 103 (1879); *Mazer* v. *Stein*, 347 U.S. 201, 217 (1954). See generally Note, 64 *Colum. L. Rev.* 1274, 1285-86 (1964).

unsettled as petitioner concedes (see Pet. Br. 33, n.32) but the very emphasis of copyright upon the mode of expression makes it ineffective to protect a true invention.

The petitioner himself recognizes that the process invented by respondents would in different computers be described differently by different specific written programs. See Pet. Br. 9, n.11. It would be relatively easy to utilize the respondents' process or, indeed, any truly inventive program, without duplicating the form of expression. Thus there is no merit to the argument that patent protection should be denied because "programs are already entitled to copyright protection" (Burroughs Br. 22). Even amicus IBM does not pretend that the copyright statute is an adequate method of protecting programs (IBM Br. 31-32).

Despite the fundamental importance of the policies represented by the Patent Act, and their direct application to the present invention, it is suggested by petitioner that patent protection is in some broad sense antithetical to public policy. Petitioner attempts to support this suggestion by citation of a wholly inapposite decision of this Court (Pet. Br. 33).[46] The plain

[46] *Deep South Packing Co.* v. *Laitram Corp.*, 40 U.S.L. Wk. 4575 (May 30, 1972). That case held that a combination patent protects the patentee only against the operable assembly of the whole combination and not the manufacture of its parts. *Id.* at 4578. The Court observed that this rule was "firmly embedded" in the patent law by decisions antedating 1952 when Congress revised the patent statute without giving any indication that it desired to change the rule. *Id.* The language quoted by petitioner was used by the court in making the point that in the circumstances it would not change long-established law without an indication of congressional intent. Petitioner cannot and does not contend here that there is any line of decisions holding that computer processes and programs are *per se* unpatentable, much less that Congress has given any indication of accepting or approving such a rule.

implication of petitioner's suggestion is that patent protection for computer processes and programs would be fundamentally inconsistent with the general policy against monopoly expressed in the antitrust laws. To invoke the policy against monopoly to support petitioner's arguments here, as amici also attempt to do, betrays a basic misunderstanding of the patent system. As the Attorney General's Committee to Study the Antitrust Laws stated:

> "By protecting such investment [in new, patented inventions]—and thereby encouraging new technologies—the patent seeks to increase competition by what is superficially an inconsistent grant of monopoly, but is in fact a mechanism intended to assure competition in invention." *Report* 25 (1955).

Given the present structure of the computer industry the granting of patents on computer processes and programs will stimulate, not restrict, competition. The production of computer hardware is highly concentrated. The few large companies that dominate that field are essentially preoccupied with the manufacture and sale of computer hardware, although until recently they have also dominated the software field as well.[47] The emerging software industry, however, presents a different picture; it is comprised of a large number of different enterprises, many of whom are

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[47] IBM alone possesses about 70 percent of the computer market (*Wall St. J.*, Aug. 3, 1972, p. 2); and, although data is hard to obtain, its share of the software market is very large. Until recently, computer manufacturers generally "gave" their software to the purchasers of their hardware. See Comment, 54 *Cornell L. Rev.* 586, 587-88 (1969). Such arrangements have recently been challenged under the antitrust laws, and increasingly the manufacturers have begun to lease their software separately. *Id.*

small (see ADAPSO Br. 3, n. 4), who have no interest in the production or distribution of computer hardware but who compete with the hardware companies in the production of computer processes and programs. The survival of such companies in the data processing field depends entirely upon their competence and skill in producing computer processes and programs. These software companies are precisely the enterprises whose competitive power will be increased by patent protection for useful, novel and unobvious advances in programming and processing.

The provision of patent protection for software will not only secure to the smaller companies the rewards of their inventions but will allow them to compete more effectively with the large hardware manufacturers who still possess a very large, though declining, share of the software market. Such patent protection would merely be equivalent to that already possessed by the manufacturers who are strengthened by the numerous patents they hold on elements of computer hardware. Software innovation by smaller, independent companies is especially valuable because, by contrast to the hardware manufacturers, the software companies' incentive to produce innovative, highly efficient software cannot be dampened or deflected by a predominant concern with the revenues to be obtained from the leasing or sale of extremely expensive computer hardware.

New and improved computer processes and programs are likely to be more efficient because they accomplish new results or the same results by fewer steps, with simpler mechanisms and in shorter time. For example, respondents' own process dispenses with the need for an adder capable of cumulating multi-digit binary numbers and lessens the amount of storage capacity that

must be provided for the computer.[48] Thus, new and inventive computer processes and programs can reduce the necessity for more complex and very expensive equipment or shorten the valuable time required for computer operations.[49] In this way the competition stimulated by patent protection benefits not only the software industry but the countless users of data processing in industry, government and in the public at large.

B. The Inconveniences That It Is Alleged Will Follow the Patenting of Computer Processes and Programs Are Overstated and Largely Unreal.

The petitioner and amici summon up a host of ills and evils that they allege will result unless this Court declares a broad and absolute judicial ban on the patenting of computer processes or programs. The dangers and difficulties invoked are not the same but in each case reflect the particular interests of the parties. While the petitioner opposes patentability because of the alleged cost and administrative inconvenience for

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[48] See also the incident described in Bender, "Computer Programs: Should They Be Patentable?," 68 *Colum. L. Rev.* 241, 247-48 n.29 (1968), in which employees of a computer user devised a program that allowed the more efficient use of certain IBM hardware without the need for additional software called an "emulator" also available from IBM. IBM, which had asserted that the program could not be developed, licensed the emulator for fees up to $6000 per month; the program was made available for sale for $9000 in total and was more efficient than the emulator as well.

[49] For example, one of IBM's most recent models of computer—Model 370/168—is reported to cost $93,000 to $170,000 for a month's rental and from $4.2 million to $7.3 million for purchase, depending on the amount of storage capacity required. *Wall St. J.*, Aug. 3, 1972, p. 2.

the Patent Office, amici assert that their hardware customers will be hampered in using the computers. Indeed, certain of the amici make suggestions, remarkable from companies whose growth and success has been so enhanced by numerous patents on hardware components, that patentability could well have "a crippling effect" on the industry (Burroughs Br. 3; see also BEMA Br. 28).

All of these assertions made by petitioner and the amici proceed from the unspoken, and fundamentally unsound, assumption that thousands of patents on computer processes and programs will be issued unless the entire field of technology is judicially carved out of the patent statute. There is nothing in the record here, in any legislative investigation, or in common experience which gives any support to this assumption. The standards of the Patent Act and the decisions of this Court applying those standards demonstrate that the assumption bears no relation to reality.

Those decisions have emphasized the height of the hurdles that an inventor must overcome to meet the statutory standards of utility, novelty and unobviousness. See *Graham* v. *John Deere Co.*, 383 U.S. 1 (1966); *Brenner* v. *Manson*, 383 U.S. 519 (1966). Of the great number of computer programs assembled each year in this country, the overwhelming majority are laborious but routine applications of well-known techniques and the resulting programs would be done in essentially the same way by other programmers. In most cases such programs could not under any circumstances surmount the unobviousness requirement that is established by statute, and for the same reason the programs could not command a substantial price if

patented so there is no incentive even to attempt to patent them.[50]

However, the exceptional processes and programs which are useful, novel and unobvious are important and deserve protection. When a major advance occurs through a truly inventive perception, it may have an extensive effect in improving computer capabilities, lessening the time and expense demanded by computer hardware use, reducing the need for apparatus elements, or otherwise promoting the advance of technology in the field. The high standard of invention, imposed by Congress and applied by this Court, assures that there will not be any improvident issuance of patents for inventions that do not pay their way in utility and inventiveness.

Apart from this initial false assumption about the scale of program patenting and its attendant problems, the problems themselves look far less substantial on careful scrutiny. Certainly this is true of petitioner's argument that patentability should be denied because expense and inconvenience will be caused to the Patent Office in developing a system of classification, searching, and filing for computer programs and processes. This is a truly amazing argument from an agency established by Congress expressly to implement the patent laws. There can hardly have been a new field

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[50] See the brief for Iowa State University Research Foundation, Inc. as amicus curiae (p. 12):

> "Of all the large number of computer programs that are written at Iowa State University, only a very small number indeed is ever considered for possible patenting. Those programs which are directed to the solution of ordinary record-keeping or computational problems are not considered as patentable because they do not rise to the level of invention called for in 35 U.S.C. 103, as interpreted by the courts."

of technology, from industrial dyes in the last century to computer hardware in this one, that has not required careful attention from the Patent Office and some expansion and adaptation of the classification system. If this line of argument were followed, the very purpose of the patent system to encourage new technologies would be frustrated at the start.

The petitioner's own activities disclose the weakness of his argument. As his own brief admits, the decision below and its predecessors have encouraged the Patent Office to undertake the development, in cooperation with the National Bureau of Standards, of techniques for classifying and searching the computer programming art (Pet. Br. 31). Comparable projects have already been successfully instituted by private users.[51] The Patent Office has established a new class in order to provide for computer program inventions, and a number of patents have issued in this class in compliance with the past decisions of the court below.[52] As previously noted, there already exists a class for devices that perform exactly the same function as respondents' process in the subclass of patents covering means of radix conversion. In short, "the potential for a workable classification system seems to be there if the Patent Office wants one." Bender, "Computer Pro-

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[51] An organization of users of IBM equipment and software called SHARE, Inc., formed and carried on with the cooperation of IBM, has developed its own system of classifying software and uses it in operating a "program library" for its members. SHARE Reference Manual (1971). Other private classification systems are unquestionably in use.

[52] Class 444 embraces patents directed to "Programmed Data Processors, Data Processing Methods and Procedures." Approximately 38 patents have been placed in this class to date.

grams: Should They Be Patentable?," 68 *Colum. L. Rev.* 241, 251 (1968).

The Patent Office argument overlooks the fact that classification of computer programs will be necessary whether or not such programs are themselves patentable. As we have noted at p. 3, above, in many instances a particular innovative advance may be embodied either in a computer program or in computer apparatus. In order to determine whether hardware apparatus is obvious in light of the prior art it is often essential to examine the prior art relating to computer programs and processes. "[E]ven if some defined area of computer programing technology were made 'non-statutory' the Patent Office would still have the burden of classifying and researching the computer programing literature because of the close interplay between the hardware and software technologies." Statement of George F. Metcalf, *Hearings before Subcommittee No. 3 of the House Committee on the Judiciary on H.R. 5924,* 90th Cong., pt. 2, at 644 (1968).

Petitioner's practical objection to patentability is doubtless made with the utmost sincerity, but it is a familiar argument that the courts have long learned to view with skepticism. "[E]xperience indicates that the grim forebodings which are frequently expressed . . . regarding the possibility that a particular decision will cause irreparable disruption of the administrative process only rarely, if ever, come to pass." *Medical Committee for Human Rights* v. *SEC,* 432 F.2d 659, 675 (D.C. Cir. 1970), *vacated as moot,* 404 U.S. 403 (1972) (footnote omitted); *accord, Office of Communication of United Church of Christ* v. *FCC,* 359 F.2d 944, 1006 (D.C. Cir. 1966). There is no reason why the patenting of computer processes and programs should

require any greater readjustment of agency procedures than the patenting of inventions in any other new field of technology including computers.

The individual amici present a more varied range of "policy" arguments. Some of them, in contending that freedom of thought and science must not be abridged, rest on a mistaken notion of the scope of respondents' claims and, particularly, on the previously refuted suggestion that claim 13 extends to mental processes and calculations (see, *e.g.*, IBM Br. 12-13 & n. 15). Certain additional arguments made by one or another of the amici—notably the argument that the programming operations would be moved abroad if held patentable here—do not deserve serious consideration.[53] At the core of the amici's basic arguments there appear to be three main contentions.

One contention made principally by IBM is that because many mathematical discoveries are so complex that they can be practically implemented only by a computer, mathematical research and development would be stifled if patents are allowed on computer processes and programs (IBM Br. 12-19). A patent

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[53] This argument, made by Burroughs (Br. 18-19) and BEMA (Br. 28-29), appears to suppose that companies will transmit their information abroad for processing in countries that do not provide computer program patents. Such maneuvers, while potentially possible for any product that is not or cannot be patented in another country, are singularly unlikely in the realm of computer operations. Almost every result obtainable from a computer can be derived through a variety of methods including ones that have long been in the public domain. It would be quite extraordinary to have a situation where the expense and inconvenience of processing in a foreign country overcame both the disadvantages of using an unpatented approach and the alternative of paying a license fee to use a more efficient one patented in this country.

does not, however, preclude the use of an invention for scientific research and educational purposes. See p. 24, n. 20. Furthermore, only a specific and practical application of a mathematical principle to the useful arts can be patented—and then only if it meets the severe statutory standards of utility, novelty and non-obviousness—so the patenting of computer programs and processes cannot give rise to wholesale preemption of mathematical discoveries.[54] Finally, the use of a mathematical technique that can be implemented by a computer is as limited by patents on the computer as by any program or process patent, and there is no warrant for any suggestion, least of all from IBM, that computer patents have stifled scientific research and investigation.

A second argument is that the computer industry is now a burgeoning one where information including programs have been freely exchanged and that its growth should not be hampered or handicapped by the necessary costs of purchasing programs (BEMA Br. 9-16). The problem with this position is that there is substantial evidence that software has not grown adequately and that secrecy has hampered development. See pp. 45, 48, above. It is also a misconception to suppose that the patenting of programs means that the user must now pay for what he formerly had without cost. "An inventor deprives the public of nothing

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[54] In this connection it should be observed that it is far from clear that the examples IBM gives in its brief of "significant mathematical discoveries . . . inextricably related to computer programming" (Br. 13) have any apparent ability to improve computer operations. Since IBM's brief does not attempt to describe specific applications of the mathematical principles to computer operations, it is impossible to determine whether *any* such application might meet the statutory requirements for patentability.

which it enjoyed before his discovery, but gives something of value to the community . . . ." *United States* v. *Dubilier Condenser Corp.*, 289 U.S. 178, 186 (1933). Through patenting and disclosure of the invention, it becomes available to the prospective user at a price; if the use of the invention is not worth the price to the user, he need not pay it.

The final line of argument is that severe administrative burdens would fall upon the *users* of computers, typically businesses in industries other than computing, who are not equipped to determine whether the programs they utilize might infringe patents previously issued. In fact, as one amicus suggests, by indemnification contract or otherwise ultimate responsibility is likely to be imposed on the organization that prepares the program, which means the hardware manufacturers or the independent software houses who currently are the sellers.[46] The alleged burden can hardly be significant for the hardware manufacturers in view of their size and resources and their experience in dealing with similar problems that arise by reason of patents on computer hardware. So far as concerns the software companies, there are grounds for concluding that they are not alarmed by the problems that the amici hardware manufacturers assert will arise. Indeed, the fact that one major trade association in the

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[46] Burroughs Br. 21-22. Indemnification contracts are, of course, widely used in broadcasting, publishing, the manufacture of parts by subcontracting, and other fields where potential copyright and patent liability may exist, in order to assure that responsibility is lodged where it belongs. IBM's standard License Agreement for IBM Program Products specifies that, subject to certain limitations, IBM will defend and pay damages resulting from copyright or patent infringement suits brought against the licensee using an IBM furnished program ("Patent and Copyright Infringement" clause).

software industry has filed an amicus brief supporting the patentability of computer processes and programs is a powerful indication that software companies believe that any burdens that may be imposed upon them will be outweighed by benefits.[14]

All patents involve limitations on the use of what has been invented and the system necessarily imposes searching requirements on those who chose to operate in the field. The basic legislative judgment has been made, however, that it is worth paying the price and bearing the inconvenience that may accompany patents because of the benefits derived from them. If in any single field or subject actual experience shows that the burden exceeds the price, Congress is free to alter the law and exclude the field. It is notable that it has rarely seen fit to do so.

C. The Case by Case Procedure Prescribed by Congress for Passing Upon Patent Applications Should Be Followed Unless and Until Altered by Congress.

The policy arguments of petitioner and amici suffer from an infirmity even more basic than their disregard of the rationale of the Patent Act and their overstatement of the difficulties that attend any system of patent protection. Most of their policy arguments are detached from and independent of both the particular standards Congress has established in the Patent Act and the specific invention involved in this case which meets those standards. Stripped to their essence the arguments of petitioner and amici ask this Court to exclude a given field of technology from the protection

[14] As a practical matter, processes or programming advances so significant and important as to merit patents are not likely to be duplicated accidentally by the user or adopted by him from some other source inadvertently and in ignorance of the patent.

of the Patent Act, not because the statute as drafted excludes inventions in the field, but because petitioner and amici believe, for reasons of convenience and expediency, that it *should* not cover such inventions.

The design of petitioner and his supporting amici is apparent not only from the very nature of many of the arguments, including those that rest explicitly on the interests or convenience of the Patent Office and the hardware manufacturers, but also from much of the reasoning and authority drawn on in the briefs to support the arguments. For example, the brief of amicus BEMA (p. 20) asserts that the decision below is "in conflict with" the 1966 *Report of the President's Commission on the Patent System* recommending against the patentability of computer programs. See also Pet. Br. 31. What BEMA fails to explain is that the *Report* never asserted that the present statute precludes patentability. In fact, the recommendation was included as part of a proposal for Congress to enact new legislation on patentable subject matter and stated that "the classes of patentable subject matter shall continue as at present, except" that design and botanical-plant patents as such shall be eliminated and computer programs shall not be considered patentable.[37]

Amici's disregard of Congress' existing statute is also manifest in the references to practice in foreign countries (IBM Br. 26-29, BEMA Br. 26-29). Some of those countries provide patent protection for com-

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[37] *Report* 12. The Commission was composed generally of high governmental officials and prominent private citizens, including an executive of amicus IBM, and did not purport to make a full analysis of existing law. In the brief discussion of computer programs the *Report* stated that "uncertainty" exists whether such programs are now patentable. *Id.* at 13.

puter programs and others do not. As we point out at pp. 65-66, below, the public policy of foreign countries is relevant, if at all, only in legislative terms and reliance on those policies is therefore an indication that petitioner and amici seek a result that should be achieved only by congressional action. The French Patent Law may provide that "programs" for use in computers shall not be patentable (IBM Br. 26, n. 32). The Patent Act enacted by Congress contains no such provision.

There are particularly persuasive reasons why this Court should not undertake a major modification of the Patent Act of the kind requested by petitioner and amici. The request is fundamentally misguided because it invites this Court to pass upon the patentability of inventions that are not before this Court and to frame a broad and far-reaching rule of exclusion in the absence of any semblance of adequate information. Any examination of the cases in the lower court involving computer-related processes is persuasive that such inventions cannot be sensibly categorized with any simple label whether it is "computer program" or any other. The inventions involved range from process inventions that employ computers in forming two-dimensional illustrations based on three-dimensional objects; methods of processing seismograms or performing spectrographic analysis of gases; and, in one case, a method of locating one particular electrical signal in a stream of such signals.[58] Whether these inventions relate to patentable subject matter and meet the stand-

[58] *E.g., In re Bernhard*, 417 F.2d 1395 (C.C.P.A. 1969); *In re Musgrave*, 431 F.2d 882 (C.C.P.A. 1970); *In re Prater and Wei*, 415 F.2d 1393 (C.C.P.A. 1969); *In re Mahony*, 421 F.2d 742 (C.C.P.A. 1970).

ards of usefulness, novelty and non-obviousness are questions that cannot be decided in gross but instead require case by case analysis of the particular nature of the invention involved.

The approach urged on this Court by petitioner and amici is also unjustified because it would require this Court to proceed in a highly technical area on the basis of factual assumptions that are disputed and to accept particular arguments of policy from the range of conflicting views held by informed experts. The discussion in this brief of the policy arguments made against the patenting of computer programs shows their conjectural nature and the questionable assumptions on which they rest. Such arguments, whatever their apparent merits or demerits, are not a sound foundation for prescribing patent policy in an entire field based on the facts of a single case.

There is no warrant for suggesting that the issuance of the particular patent here involved will have an adverse effect upon petitioner, the individual hardware manufacturers who appear as amici, or the computer industry. The invention is a useful one but only one of a number of alternatives available to achieve BCD-to-binary signal conversion in a digital computer. The theory that this case should decide whether "computer programs" as such are patentable is based on a false notion that each of the inventions loosely labeled in this fashion should be treated in the same way under any of the statutory criteria. While any decision of this Court must provide guidance in many other cases, the sound tradition of treating each invention on the basis of the particular facts should not be abandoned here.

Nothing in the decisions of this Court supports any attempt to narrow or confine the constitutional and statutory concept of "invention" to exclude either apparatus or processes *en masse* in any designated field of technology. The phrase, adopted in an age of agricultural tools and elementary machines, has been found applicable to chemical processes, electrical methods and apparatus and the most advanced scientific fields of technology available today. None of the Court's decisions have ever suggested that each new technology requires an amendment of the statute in order to sanction patents for it (compare, *e.g.*, Pet. Br. 32-33; Burroughs Br. 24-25; IBM Br. 31-33).[59] In each new technological field, this Court has examined the invention itself to determine whether the standards of utility, novelty and non-obviousness have been met.

The case by case approach to patent applications is the approach devised by Congress and followed by it with the rarest exceptions throughout the several revisions of the basic patent legislation. There is, in fact, only one field of invention that Congress has excluded as such from patent protection—inventions solely useful in producing atomic weapons.[60] In two other cases, design and plant patents, Congress has provided spe-

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[59] The term "invention" is, in this respect, an expansive one which is not to be compared with the more precise and limited subject matter for which copyright is available. Compare *White-Smith Music Co.* v. *Apollo Co.*, 209 U.S. 1 (1908).

[60] See 42 U.S.C. § 2181(a). The policies that have led to this exclusion obviously have no bearing on this case. Where patented inventions useful generally in the atomic energy field are used in atomic weapons, the patent does not extend to this use. 42 U.S.C. § 2181(b). Congress has, however, substituted a system of awards to provide compensating incentive in such cases. 42 U.S.C. § 2187 (b)(3).

cial statutory rules for these special fields while retaining the basic concept of patentability. See 35 U.S.C. §§ 161-173. This not only shows that Congress is fully capable of treating fields of endeavor separately under the Patent Act when it wishes to do so but confirms that such special treatment is a rare exception to the basic policy of Congress to apply general statutory standards to determine the patentability of specific inventions.

The policy arguments framed by petitioner and amici are thus "misaddressed" and ought properly to be "addressed to Congress." See *Lauritzen* v. *Larsen*, 345 U.S. 571, 593 (1953). Proposals to exclude patents relating to computer programs have in fact been made, although with no success to date. See Pet. Br. 32. At the very least, however, these proposals normally contain some statutory provision that would adequately define the type of invention excluded from protection. How those definitions would apply in particular cases —including the process involved in this one—depends on their particular terms.

The patent area is not one that Congress has neglected, nor has it been unwilling to alter the statute as circumstances advise. There was a major revision of the statute in 1952 and bills for a further revision have recently been introduced and considered.[61] If there is any substance to the arguments made by amici, Congress is fully able to respond to them. It may be doubted, however, whether there is anything so extra-

[61] The Administration bill introduced to implement the recommendations of the 1966 Commission (see p. 61, above) contained a provision denying patentability to computer programs. After hearings were held on the bill, the provision was omitted from subsequent versions. See Pet. Br. 32-33.

ordinary and peculiar about inventions of the type here involved that Congress will abandon the general standards that have covered so many diverse and ingenious inventions in the past.

The presence of a particularized statutory system and Congress' continuing oversight makes the reliance of amici on the practice of foreign countries especially unpersuasive. No matter what policy those countries might adopt, the patent system in this country is a statutory one and foreign practice is at best a precedent of interest to Congress. However this may be, the practice abroad is varied and several important countries (*e.g.*, England, Canada, Germany) do in fact appear to offer patent protection for computer processes and programs. See brief of amicus Mobil (pp. 37-42); Pet. Br. 34, n. 33.

CONCLUSION

For the reasons stated, the judgment below should be affirmed.

Respectfully submitted,

HUGH B. COX
HENRY P. SAILER
MICHAEL BOUDIN
888 Sixteenth Street, N.W.
Washington, D.C. 20006

WILLIAM L. KEEFAUVER
ROBERT O. NIMTZ
600 Mountain Avenue
Murray Hill, New Jersey 07974

Attorneys for Respondents

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